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The RACE Program: A 1989 Update

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Early plans for the program called Research and Development in Advanced Communications Technologies for Europe (RACE) were reported in ESN 39-3:122-123 (1985), a comprehensive description of the work of the definition phases carried out in 1986 was given in ONRL Report No. 8-014-R (August 1988), and the RACE Program in 1988 was described in ONREUR Report 9-7-C (March 1989). The work in RACE addresses the technical and economic options for the development of an advanced information infrastructure. However, strategic analyses of demand for powerful and cost-effective services determines the orientation of the technical work. This report will go into a little more depth in some areas of the work and will describe several projects started since the Report No. 9-7-C was written; that report briefly described projects 1001 through 1048.

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The RACE Program: A 1989 Update

Introduction

Early plans for the program called Research and Development in Advanced Communications Technologies for Europe (RACE) were reported in *ESN* 39-3:122-123 (1985), a comprehensive description of the work of the definition phases carried out in 1986 was given in ONRL Report No. 8-014-R (August 1988), and the RACE Program in 1988 was described in ONREUR Report 9-7-C (March 1989). This report will go into a little more depth in some areas of the work and will describe several projects started since Report No. 9-7-C was written; that report briefly described projects 1001 through 1048.

Nearly all of the European Community (EC) and European Free Trade Association Telecommunications and Telematics Equipment Manufacturers, as well as major users of telecommunications, are participating in the framework of the RACE Program. The program is addressing the matter of providing Europe in a timely manner with advanced telecommunications services required for continued economic and political strength and for completion of the Internal Market in 1992.

Joint teams of technical experts are collaborating in producing common functional specifications for Integrated Broadband Communications (IBC) and in the development of the technologies required for the application of advanced technologies in an economic fashion. Throughput, cost effectiveness, and technical performance are important in arriving at the best solution.

The management and transport of information throughout the world has a turnover of over 500 billion European Currency Units (ECU). The world market for telecommunications equipment alone is well over 80 billion ECU and that for services is more than three times as large and is growing rapidly. By 2000, the EC will have invested an additional 500 billion ECU in telecommunications and the sector will account for about seven percent of Gross Domestic Product, compared with two percent in 1984. Inevitably, employment and the continued prosperity of Europe will be affected in a major way by the developments in telecommunications. Probably 60 million jobs in Europe will depend on the international competitiveness of Europe's information infrastructure and services in 2000.

The work in RACE addresses the technical and economic options for the development of an advanced information infrastructure. However, strategic analyses of demand for powerful and cost-effective services determines the orientation of the technical work.

The first strategic audit of RACE was carried out in 1988 by independent specialists familiar with key political and technical developments. The audit concentrated on global objectives and priorities, taking into account political, social, economic, technical, and industrial developments and the evolution of demand for advanced telecommunications. As of this writing, its conclusions were generally favorable and a second strategic audit is underway.

Within the EC, 11 telecommunications administrations, 89 universities and research establishments, and over 230 companies are now involved in RACE consortia. Organizations from 11 of the 12 European countries are represented. Also, 32 organizations from Austria, Finland, Norway, Sweden, and Switzerland participate in 39 consortia.

Projects Not Covered In ONREUR Report 9-7-C

Following are RACE projects, listed by project number and name:

1049 - Asynchronous Transfer Mode (ATM) Concept. Project 1049 considers the specifications of header functions for ATM cells and of the ATM layer protocol. Furthermore, this project will also address ATM-related signaling aspects.

1050 - Integrated Broadband Communications (IBC) Application Analysis. This project deals with the analysis of applications to determine criteria to define the scope for IBC activities.

1051 - Multigigabit Transmission in the Integrated Broadband Communication Networks (IBCN) Subscriber Loop. This is one of several customer access projects covering the topic of Customer Access Connection (CAC) using direct detection techniques. One project concentrates on a switch for interactive services and traffic engineering for the CAC; while the problems of passive optical components and the distribution switch are addressed by another project; yet another deals with very high bit rates (Project 1051, 5-10 Gbits/s). Although this project deals specifically with high bit rates for the CAC, it will also have relevance to long haul links. The emphasis of these projects is on the cost reduction of the customer access and on the development of customer laboratory demonstration models.

Dr. Blackburn is the London representative of the Commerce Department of Industrial Assessment in Computer Science and Telecommunications.

1052 - Signal Processing for Optical and Cordless Transmission (SPOT). The main objectives of this project are to develop and investigate signal processing techniques for optical and cordless transmission links to be employed in customers premises networks. Some of these techniques may also be of interest for other applications.

1053 - TERRACE-Telecommunications Management Network (TMN) Evolution of Reference Configurations for RACE. This project is concerned with the development of a set of reference configurations for the TMN, as part of the overall ICBN Reference Configuration. The study of an evolution scenario to a pan-European TMN is also one of the major objectives of TERRACE.

1054 - Application Pilot for People with Special Needs (APPSN). The aim of this project is to act as a trial of support for the elderly, deaf, hard of hearing, blind, and those with reduced mobility. The support services will enable service providers to be in immediate contact with the home-based person by using videotelephone. The project will provide for several service centers, each capable of supporting up to 100 special video terminals, on an analogue broadband, or digital 2 Mbits/s, or 64 Kbits/s, network of star topology.

1055 - Methods in Electronic Retail Cash Handling Using Advanced Network Technologies (MERCHANT). The goal is to progress toward an advanced European Electronic Retail Payment system with plastic cards that will take IBC into account. This will be achieved by connecting nonconnected networks, by developing user interfaces with image, voice and data, and finally, by ensuring that security aspects are taken into account.

1056 - BIPED. This project contributes to the area of IBC Customer Systems and Integration in such a way that it allows an early integration of terminals, Customer Premises Networks (CPNs), Customer Access Connection, and local exchange. The scope of Project 1081 is slightly broader than that of Project 1056, since many terminal projects are involved in Project 1081. However, both projects are closely related and even a physical integration between these two projects is foreseen. They also contribute to the area of verification.

1057 - AQUA-Advanced Quantum Well Lasers for Multigigabit Transmission Systems. This project intends to achieve high modulation bandwidth together with high power output and efficiency. Good temperature stability and a thorough understanding of carrier transport and relaxation mechanisms are also important objectives of this project.

1058 - Remote Expert Support for Aircraft Maintenance (RESAM). The objective is to develop and evaluate the usability of an information system for aircraft maintenance. The system should improve security for the users and reduce costly immobilization time for the aircraft on the ground. This will be a conferencing system with voice, text, graphics data, image and video communication. Databases will be included from the company and the manufacturer, along with authentication and encryption of information.

1059 - DIVIDEND. This consists mainly of videophone service enabling eye-to-eye contact between dealers in the financial dealing sector and using a broadband communications network.

1060 - RPA Distributed Industrial Design and Manufacturing of Electronic Subassemblies (DIDAMES). Application of local and wide area broadband networks within a distributed industrial design and manufacturing system for electronic subassemblies (multilayer printed circuit boards). This will take into account the sharing of computer-aided design/computer-aided manufacturer (CAD/CAM) techniques between design and manufacturing locations, supported by a voice- and video-based teleconferencing system, and will demonstrate the usefulness of international data interchange standards.

1061 - Distributed Integrated Multimedia Publishing Environment (DIMPE). This project is aimed at creating an environment enabling a wide range of commercially viable publishing services to be provided over the IBC. Great emphasis is on obtaining a clear understanding of user requirements. The aim is to use existing technologies such as peripheral publishing equipment and the broadband network infrastructure. The project will also focus on and promote all aspects of standardization in this application area.

1062 - MARIN-ABC. The aim is to demonstrate the use of broadband/narrowband communications in the maritime industry, and more precisely, to help solve nonroutine maintenance and repair problems onboard ship with the assistance of shore based experts. This will involve the use of data and voice, together with still and moving picture transmission.

1063 - Mobile Applications Pilot Schemes. The project consists of four applications that are intended to demonstrate the need for mobile communications:

1. Broadcaster's production communications/Major event coverage
2. Courier services
3. Public utilities, operation, and maintenance
4. Rail transport.

1064 - Monolithic Integrated Optics for Customer Access Applications (MIOCA). The main objectives of this project are the integration of various optical functions such as optical amplification, light emission, wavelength division multiplexing, or light reception. The project is to

develop monolithic integrated optical components and to assess the potential of this technology for high performance, manufacturable components in subscriber and customer access systems of the Integrated Broadband Computer Network.

1065 - IBCN Systems and Services Usability Engineering (ISSUE). Using emulation techniques, ISSUE will investigate experimentally the important usability issues of videocommunication and multimedia retrieval services. The project will develop through a multi-disciplinary approach. The aims are to identify the main factors governing services' acceptability to the users and to provide inputs to the RACE usability database and application pilots.

1066 - Integration of People and Special Needs by IBC (IPSNI). This project will include study of the functional requirements for enabling visually and motor/speech handicapped people to use IBC terminals and services.

1067 - GUIDANCE - Usability Design Information Support for the Integration of IBC Services. The purpose is to cover the issues of integrated dialogue and retrieval services, using the multimedia terminal from Project 1038 as its vehicle for experimentation.

1068 - RACE Open Services Architecture (ROSA). This area, which is relevant to telecommunication software, includes the technique for service provision and especially the techniques necessary for the integration of services. Service provision is the fast-growing branch of telecommunications. The major obstacle in satisfying the needs of potential users will probably be in the difficulty to produce the corresponding software, as the current generation of telecommunication systems tend to be intractable and unwieldy in the face of rapidly changing requirements. This project will develop and define an open architecture for distributed online telecommunications systems especially designed to considerably reduce the cost and time for the introduction of unforeseen facilities, features, and services.

1069 - Enhanced Performance Lasers for Optical Transmitters (EPLOT). This project is directed towards high power output and power handling for optical amplifiers. Narrow line-widths for use in CMC and wave division multiplexing applications is a prime target, as is low reflection sensitivity.

1070 - Testing Pay-Per-View in Europe. In this project, pay-per-view TV will be tested in three locations; Biarritz, France; Limburg, Holland; and Berlin, Germany. An appropriate man-machine interface, with as many common elements as possible, will be developed to ensure comparability of the results from these tests. Specialized software for traffic modeling and evaluating tools will also be developed to assist in determining strategies for the introduction of pay-per-view and the transition to IBC.

1071 - IBC Application Analysis (Phase 2). This project deals with the analysis of applications--to provide a basis for the development of entry strategies and pilots for IBC, and to enable IBC services to achieve maximum momentum, using empirical and robust data.

1072 - IBCN Testing Architecture for Conformance Assessment (ITACA). Project ITACA expects to identify the methodologies, procedures, and tools needed to define an IBCN conformance testing system able to handle the high data rates of IBCN. Testing tools and equipment will not be produced, but the relevant requirements will be specified.

1073 - GEOTEL. The purpose of GEOTEL is to create a library service for the petroleum and chemicals industry. Two main servers, located in London and Paris, will use optical disk data storage and workstations will be spread all over Europe. The data bank will include patents, CAD/CAM drawings, and seismic surveys.

1074 - Electronic Case Handling in Offices (ECHO). This application pilot is concerned with the installation of an electronic case handling system within an existing department of an insurance company to automate a current-ly paper-based process. The distributed system of workstations and servers on a local network at one location will use a public broadband network to communicate with other locations. The workstations will have high resolution screens with advanced graphical user interfaces and the servers will be dedicated to the storage of databases, images, and voice information on both magnetic and optical media.

1075 - TELEPUBLISHING. This project is to bring the European printing and publishing industry and users of their equipment up to the current state of the art in computer, software, and communication technology. This application is designed to demonstrate a future working scenario in a broadband environment, to allow easy and time-saving interaction between distributed locations of the printing and publishing industry. The application should realize all functions from design, layout text, and image production down to printing and production.

It targets three domains--electronic newspaper editing, school textbooks, and magazine printing--in which there is currently a high degree of incompatibility of the equipment and transmission protocols. The project will thus focus on standardization aspects for the edition of documents, document exchange, and the open interconnection and exchange of information between heterogeneous systems.

1076 - Reference Models for Usability Specifications (REMUS). The objective of REMUS is to establish a database of agreed usability design targets for the relevant user/task/tool/environment combinations in the IBC applications. The database should help the IBC system, services, and terminal designers to develop man/machine interfaces that are consistent across a wide range of applications.

1077 - Usage Reference Model for IBC. This project will provide usage reference models for the different types of usage design issue. It deals with three areas--the establishment of the conceptual framework, the collection and synthesis of usage data, with usage-FRM mappings and usage-RC mappings, and the output of usage reference data to RACE designers and standards/external bodies.

1078 - European Museums Network. The purpose is to demonstrate the usefulness of broadband communication in the cultural field. The network uses the so-called associative approach to give a visitor to one museum, among fifteen in Europe, access to information in the archives of the others. In this way, the visitor will be able to obtain details or explanations of an artwork; e.g., a painting, object, or sculpture, which is not physically available at the museum being visited. The network will use multimedia workstations and mix still images, video images, sound, music, and text.

1079 - CAR-CAD/CAM for the Automotive Industry in RACE. The objective is to integrate the design team, the manufacturing plants, and parts suppliers into one distributed entity. The aim is to improve the efficiency of the European automotive industry by accelerating design to production timescales and the modification processes. Better coverage of information will be provided for all involved, including car dealers. Use of video/voice communication will be investigated in addition to high-speed data communications as a means of strengthening human-to-human relationships in a high technology environment.

1080 - High Definition TV (HDTV) Experimental Usage. Following the demonstration of the EUREKA 95 equipment at IBC'88 Brighton, the purpose is to acquire practical experience with this evolutionary, compatible, HDTV system. The aim is to provide facilities for experimental use of the European HDTV approach that will demonstrate the complete range of HDTV production tools, including emission and reception equipment, by using them to cover major events in and outside Europe.

1081 - Broadband User Network Interface (BUNI). Both Projects 1081 and 1056 contribute to the area of IBC customer systems and integration in such a way that they allow an early integration of terminals, CPNs, CAC, and local exchange. Since many terminal projects are involved in Project 1081,the scope of Project 1081 is slightly broader than Project 1056. Also, the two projects will carry out measurements of quality and service to verify whether the requirements of services can be met. These measurements will be supported by Project PARASOL which will provide a traffic analyzer and generator.

1082 - QOSMIC-QOS Verification and Tools for Integrated Communication. The main objectives of Project 1082 are to

- Define IBC quality of service requirements by analyzing existing networks, analyzing QOS requirements of IBC services, and evaluating QOS verification techniques
- Define QOS verification methodology and mapping QOS to network performance
- Document QOSMIC assumptions and requirements.

1083 - PARASOL-ATM Specific Measurement Equipment. This project will study aspects of the measurement and verification technologies required to support the introduction of ATM technology for IBCN.

1084 - MIME - Development of Emulators and Simulators. This project will handle the requirements of the Telecommunication Management Network (TMN) area for emulators and simulators. The project will identify those other areas of the IBC in which the application of emulation and simulation will have an impact and produce suitable emulation/simulation systems.

1086 - TELEMED. The main objective is to demonstrate the potential of IBC for medical record transmission, management, and control to allow clinical and research staff to work together on diagnosis and therapy methods using multimedia workstations.

1087 - PROVE - Provision of Verification. The main objectives of this project are to provide

- Recommend standardizing methods and procedures for verification of IBC
- Recommend reducing the need for and simplify the interoperability testing
- Define testability and maintainability concepts and proposal of a strategy to introduce the concepts into the design phase
- Recommend methodology for computer aided generation of test cases
- Collect all information needed to establish a common verification testing and maintenance concept
- Recommend access for verification of IBC, supported by test reference configurations
- Standardize verification methods and procedures by supporting the 1045 consortium activities with technical expertise

- Establish feasibility for following verification tools: traffic load generator, interfaces to ATM/Hybrid system access, and signaling control unit
- Develop prototypes as recommended by the October '89 Audit Panel.

1088 - TUDOR - Usability Issues for People with Special Needs. The main objective is to show the importance of considering the special needs and wants of groups within the general population; e.g., elderly and handicapped, in the design of IBC.

TV and HDTV In The Context of the RACE Program

The RACE program is concentrating on integrated broadband communications where, by definition, telecommunications services such as voice and data are integrated with visual services such as TV distribution to merge the two main streams of communication. The most stringent requirements for bandwidth are those that arise from the visual services.

Even though RACE has been conceived by specialists coming mainly from telecommunications, the importance of television has never been disregarded and the RACE workplan has provided for a fair amount of activity. The response to the first call for proposals has established a credible framework for TV-related activities. The embedding of the EUREKA 95 Project into this framework considerably enhances the visibility of RACE in the context of television.

The activities related to TV/HDTV in RACE cover the chain from the studio down to the TV user. The work currently under contract in RACE corresponds to a total effort of about 300 million ECU. The RACE projects related to TV are

1. Studio. Project 1036 deals with wavelength and time division multiplexed broadband customer premises network (TV/Studio)

2. Switching. Switching projects address all switching services; however, the most stringent requirements are posed by video switching

- 1012 - BLNT-Broadband local network technology
- 1014 - ATMOSPHERIC
- 1022 - Technology for asynchronous time division
- 1013 - HDTV switching

3. Video Coding

- 1018 - HIVITS-High quality videotelephone and high-definition television system
- 1041 - FUNCODE functional specification of codecs

4. Transmission

- 1051 - Multigigabit transmission (10Gbit/s)
- 1030 - Access
- 1010 - Subscriber CMC system

5. Terminals

- 1001 - Digital video tape recording terminal for HDTV

6. Demonstrators

- 1080 - HDTV experimental usage (EUREKA 95)

Mobile Communications in the Context of the RACE Program

The concept of IBC as understood by the RACE program requires satellite and mobile communications, as well as the terrestrial "fixed network" aspects, to be taken into account.

The mobile services are expanding rapidly as the cost of mobile terminals drops. Before the end of the century, a low-cost pocket telephone will be possible and desirable. Also, existing mobile communications are provided by overlay networks linked to the fixed networks at only a few points.

In the context of IBC, mobile communications are considered as an integral part of IBC, and several tasks in this field appear in the RACE workplan. The mobile project 1043, in which a large number of major industries and primary telecommunications operators in the area participate, was incorporated in the RACE program following the first call for proposals. The cooperation between the partners of the two sectors will ensure its technical viability, as well as a high degree of acceptance among the telecommunications operators.

The RACE mobile project is paying special attention to the impact that mobile communications have on the fixed network. Compared with the fixed network, public mobile communications is in its infancy but, driven by commercial pressures, is evolving very quickly. Ideally, any IBC service available on the fixed network should also be available to the mobile user. However, frequency-spectrum and economic constraints limit the practical possibilities.

The second call for proposals identified activities on verification to permit a cost-effective integration of mobile communications into IBC while providing the required quality of service level. All activities in the field of mobile communications are being undertaken by the RACE Project 1043.

Also, mobile aspects are addressed in the Application Pilot Project 1063. This establishes four pilot schemes that will demonstrate the need for and the utility of various mobile aspects of IBC.

RACE Mobile Project 1043 covers two main classes of mobile service:

1. Universal Mobile Telecommunications System (UMTS) to provide speech and low-to-medium rate data

service. This is to achieve virtually complete geographical coverage.

2. Microwave broadband to provide very high bit rate connections to mobile units. In the foreseeable future, such systems cannot provide complete geographical coverage but will be important for certain specified applications.

The goal of the UMTS is a standard flexible air interface for all classes of service; e.g., cordless telephony, cordless PABX, cellular radio. The UMTS concept is an approach within RACE that is expected to evolve during the course of the program (see Table 1).

Table 1. UMTS Key Elements

- A common standard for public cellular systems and private cordless telephones with full interworking
- Very low-cost personal terminals; i.e., a mass-market pocket telephone
- An infrastructure comprising a mixture of public and private cells connected to the IBCN to allow growth constrained only by economics
- High bit-rate radio channels designed to carry a wide range of data services including video and graphics, short messages, and large data files.

The nine core tasks of the project are fixed network mobile functions, mobile system and services, radio bearer, cellular coverage, channel management, signal processing, technology, mobile broadband services, and verification models for different networks.

The RACE Mobile Application Pilot Schemes. Project 1063 has four pilot schemes designed on the principle of a scale model in which a small group of users will receive a service using existing technology (see Table 2).

Table 2. Mobile Application Pilot Schemes

- Broadcasters' production communications/event coverage
- Courier services
- Public utilities, operation, and maintenance
- Rail transport.

The projects are expected to generate justification for the allocation of additional frequencies in the radio spectrum for mobile communications.

Reference

Research and Development in Advanced Communications Technologies in Europe, March 1989, Directorate General XIII, Commission of the European Communities.